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What is claimed is:

1. A charged-particle-beam mapping projection-optical system,
comprising:
 - 5 (a) an irradiation-optical system that directs an irradiation charged
particle beam along a first axis from an irradiation-beam source;
 - (b) an E×B beam separator configured and situated to receive the
irradiation beam from the irradiation-optical system and to direct the irradiation
beam downstream of the E×B beam separator;
 - 10 (c) an objective-optical system configured and situated to receive the
irradiation beam from the E×B beam separator, direct the irradiation beam to be
incident on a surface of a specimen located at a position downstream of the
objective-optical system, receive an observation charged particle beam generated
by impingement of the irradiation beam on the specimen surface, and direct the
15 observation beam to the E×B beam separator, wherein the E×B beam separator
causes the observation beam to propagate along a second axis having a direction
different than the first axis;
 - (d) an imaging-optical system configured and situated to receive the
observation beam from the E×B beam separator and to direct the observation beam
20 from the E×B beam separator to a detector; and
 - (e) an adjustment-beam source configured to emit an adjustment
charged particle beam, the adjustment-beam source being situatable at the
specimen position so as to direct the adjustment beam, in place of the observation
beam, through the objective and imaging-optical systems to the detector.
- 25 2. The system of claim 1, wherein the adjustment-beam source
produces the adjustment beam having an emission profile, at the specimen
position, corresponding to at least one of a dot, a line, a plane, a cross, or an L-
shaped profile.

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3. The system of claim 1, wherein the adjustment beam is an electron beam.

4. The system of claim 1, wherein the adjustment-beam source
5 produces the adjustment beam having a kinetic energy equal to a kinetic energy of the observation beam as generated at the specimen surface.

5. The system of claim 1, wherein the adjustment-beam source comprises a cold cathode.

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6. The system of claim 1, further comprising an electrode situated object-wise of the objective-optical system, the electrode being operable to generate a potential relative to the adjustment-beam source sufficient to accelerate the adjustment beam as the adjustment beam propagates to the detector.

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7. In a method for operating a charged-particle-beam mapping projection microscope, wherein an irradiation charged particle beam is directed along a first axis from an irradiation-beam source through an irradiation-optical system to an E×B beam separator, then passed through the E×B beam separator and
20 through an objective-optical system so as to cause the irradiation beam to impinge on a surface of a specimen at an object-surface plane and generate, from the impingement, an observation charged particle beam propagating from the specimen toward the objective-optical system; and the observation beam is passed through the objective-optical system and the E×B beam separator along a second axis
25 having a different direction than the first axis, and then through an imaging-optical system to a detector, a process for adjusting the objective-optical system and imaging-optical system, comprising:

(a) at the object-surface plane, replacing the specimen with an adjustment-beam source that emits an adjustment charged particle beam; and

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(b) while passing the adjustment beam through the objective-optical system, the E×B beam separator, and the imaging-optical system, applying electrical power only to the objective-optical system and determining one or more of an axial alignment and an aberration characteristic of the objective-optical system.

8. The process of claim 7, further comprising the step of adjusting the one or more of an axial alignment and an aberration characteristic of the objective-optical system.

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9. The process of claim 7, further comprising the step, after step (b), of applying electrical power to the imaging-optical system as well as the objective-optical system, and determining one or more of an axial alignment and an aberration characteristic of the imaging-optical system.

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10. The process of claim 9, further comprising the step of adjusting the one or more of an axial alignment and an aberration characteristic of the imaging-optical system.

20 11. A charged-particle-beam mapping projection-optical system, comprising:

(a) an irradiation-optical system that directs an irradiation charged particle beam along a first axis from an irradiation-beam source;

(b) an E×B beam separator configured and situated to receive the irradiation beam from the irradiation-optical system and to direct the irradiation beam downstream of the E×B beam separator;

(c) an objective-optical system configured and situated to receive the irradiation beam from the E×B beam separator, direct the irradiation beam to be incident on a specimen surface located at an object-surface plane downstream of the objective-optical system, receive an observation charged particle beam

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generated by impingement of the irradiation beam on the specimen surface, and direct the observation beam to the E×B beam separator, wherein the E×B beam separator causes the observation beam to propagate along a second axis having a direction different than the first axis;

5 (d) an imaging-optical system configured and situated to receive the observation beam from the E×B beam separator and to direct the observation beam from the E×B beam separator to a first detector;

(e) an alignment-beam source configured to emit an alignment beam with respect to the object-surface plane so as to cause the alignment beam to
10 acquire data regarding an alignment characteristic of the object-surface plane; and

(f) an alignment-optical system situated off-axis from the objective and imaging-optical systems and configured to direct the alignment beam from the object-surface plane to a second detector that detects the data.

15 12. The system of claim 11, wherein the alignment-beam source is situatable at and movable within the object-surface plane.

13. The system of claim 12, wherein the alignment-beam source is defined on a fiducial plate.

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14. The system of claim 13, wherein the fiducial plate comprises a fiducial mark.

15. The system of claim 11, wherein the alignment beam is a beam of
25 light.

16. The system of claim 11, wherein the alignment beam is a charged particle beam.

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17. The system of claim 16, wherein the alignment beam is an electron beam and the off-axis optical system is a scanning electron microscope.

18. The system of claim 16, wherein the alignment-beam source has an
5 emission profile at the object-surface plane, the emission profile being at least one of a dot, a line, a cross, or an L-shaped profile.

19. The system of claim 16, wherein the alignment beam has a kinetic energy equal to a kinetic energy of the observation beam.

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20. The system of claim 16, wherein the alignment-beam source comprises a cold cathode.

21. The system of claim 16, wherein an electrical potential exists
15 between alignment-beam source and an object-wise surface of the objective-optical system, the potential causing an acceleration of the alignment beam as the alignment beam propagates through the objective-optical system.

22. In a method for operating a charged-particle-beam mapping
20 projection microscope, wherein an irradiation charged particle beam is directed along a first axis from an irradiation-beam source through an irradiation-optical system to an E×B beam separator, then passed through the E×B beam separator and through an objective-optical system so as to cause the irradiation beam to impinge on a surface of a specimen at an object-surface plane and generate, from the
25 impingement, an observation charged particle beam propagating from the specimen toward the objective-optical system; and the observation beam is passed through the objective-optical system and the E×B beam separator along a second axis having a different direction than the first axis, and then through an imaging-optical system to a detector, a process for adjusting the objective-optical system and
30 imaging-optical system, comprising:

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(a) placing an adjustment-beam source at the object-surface plane, the adjustment-beam source being operable to emit an adjustment charged particle beam; and

(b) adjusting an electrical potential and an electrical current applied to the E×B beam separator so as to align an image formed on the detector by the adjustment-beam source when electrical potential and electrical current are not applied to the E×B beam separator with an image formed on the detector by the adjustment-beam source when electrical potential and electrical current are applied to the E×B beam separator.

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23. The process of claim 22, wherein:

the imaging-optical system comprises a stigmator that corrects aberration in the image formed on the detector; and

step (b) comprises adjusting an electrical energy applied to at least one of the objective-optical system and the imaging-optical system while adjusting the electrical potential applied to the detector.

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24. The process of claim 22, wherein the adjustment beam is an electron beam.

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25. The process of claim 24, wherein the adjustment beam has a kinetic energy equal to a kinetic energy of the observation beam.

26. The process of claim 22, further comprising providing a potential difference between the adjustment-beam source and a specimen-wise surface of the objective-optical system, the potential difference serving to accelerate the adjustment beam.

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27. A charged-particle-beam mapping projection-optical system, comprising:

(a) an irradiation-optical system that directs an irradiation charged particle beam along a first axis from an irradiation-beam source;

5 (b) an E×B beam separator configured and situated to receive the irradiation beam from the irradiation-optical system and to direct the irradiation beam downstream of the E×B beam separator;

(c) an objective-optical system configured and situated to receive the irradiation beam from the E×B beam separator, direct the irradiation beam to be
10 incident on a specimen surface located at an object-surface plane downstream of the objective-optical system, receive an observation charged particle beam generated by impingement of the irradiation beam on the specimen surface, and direct the observation beam to the E×B beam separator, wherein the E×B beam separator causes the observation beam to propagate along a second axis having a
15 direction different than the first axis;

(d) an imaging-optical system configured and situated to receive the observation beam from the E×B beam separator and to direct the observation beam from the E×B beam separator to a first detector;

(e) an adjustment-beam source configured to emit an adjustment beam
20 with respect to the object-surface plane so as to cause the adjustment beam to acquire data regarding a position of the object-surface plane; and

(f) the E×B beam separator being connected to a variable-power supply to permit an electrical potential and an electrical current applied to the E×B beam separator to be adjusted as required such that an image formed on the detector by
25 the adjustment beam when electrical potential and electrical current are not applied to the E×B beam separator is aligned with an image formed on the detector by the adjustment beam when electrical potential and electrical current are applied to the E×B beam separator.

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28. A charged-particle-beam mapping projection-optical system, comprising:

(a) an irradiation-optical system that directs an irradiation charged particle beam along a first axis from an irradiation-beam source;

5 (b) an E×B beam separator configured and situated to receive the irradiation beam from the irradiation-optical system and to direct the irradiation beam downstream of the E×B beam separator;

(c) an objective-optical system configured and situated to receive the irradiation beam from the E×B beam separator, direct the irradiation beam to be
10 incident on a specimen surface located at an object-surface plane downstream of the objective-optical system, receive an observation charged particle beam generated by impingement of the irradiation beam on the specimen surface, and direct the observation beam to the E×B beam separator, wherein the E×B beam separator causes the observation beam to propagate along a second axis having a
15 direction different than the first axis;

(d) an imaging-optical system configured and situated to receive the observation beam from the E×B beam separator and to direct the observation beam from the E×B beam separator to a first detector;

(e) an adjustment-beam source configured to emit an adjustment beam
20 with respect to the object-surface plane so as to cause the adjustment beam to acquire data regarding a position of the object-surface plane; and

(f) an evaluation chart configured so as to be insertable at the object-surface plane, the evaluation chart spontaneously emitting an evaluation electron beam for evaluating an optical-performance characteristic of the imaging-optical
25 system.

29. The system of claim 28, wherein the evaluation electron beam has a kinetic energy that is equal to a kinetic energy of the observation beam.

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30. The system of claim 28, wherein the evaluation electron beam has an emission profile selected from the group consisting of a dot-shaped profile, a line-shaped profile, or a planar profile.

5 31. The system of claim 28, wherein the evaluation chart comprises a hot-electron emitter.